Water Supply and Disposal Considerations in Mission Sustainability

Presentation to

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CH2MHILL

Water Risks are Real and Current!

Population Growth and Industrial Development will Decrease Per Capita Water Availability

IPCC: Climate Change will Increase Droughts and Floods

Discharge Regulations are Increasingly Stringent

2007 News

Flood threat to Bangladesh a warning to the world

Global warming debate begins

Mideast water warning

Howard backed over water plan

By Raphael Minder in Sydney

COLORADO BASIN

Scientists warn of US water shortages

By Clive Cookson in London

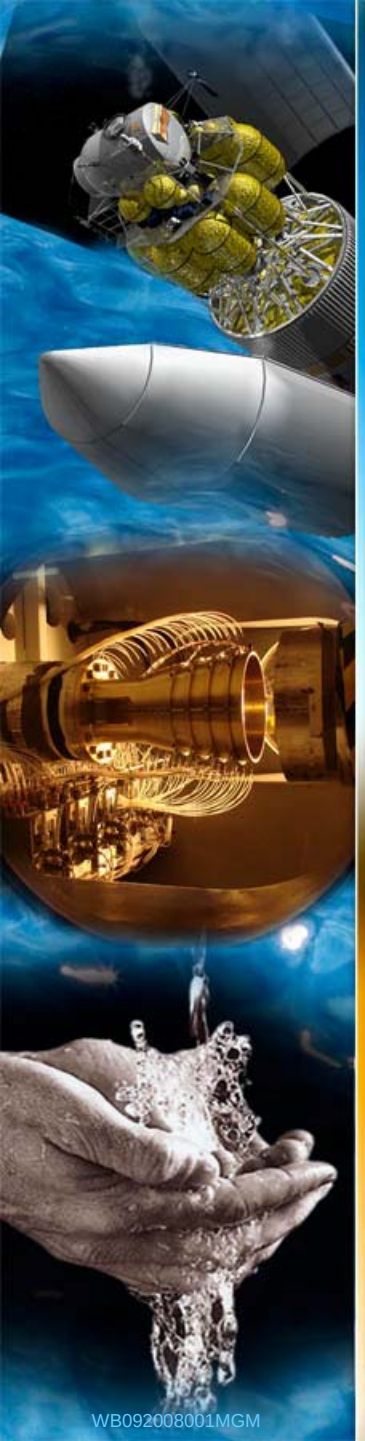
REUTERS FOUNDATION

Indian tech city nervou ruling

CNN.com

Drought threatens 1.5 million in southwest China

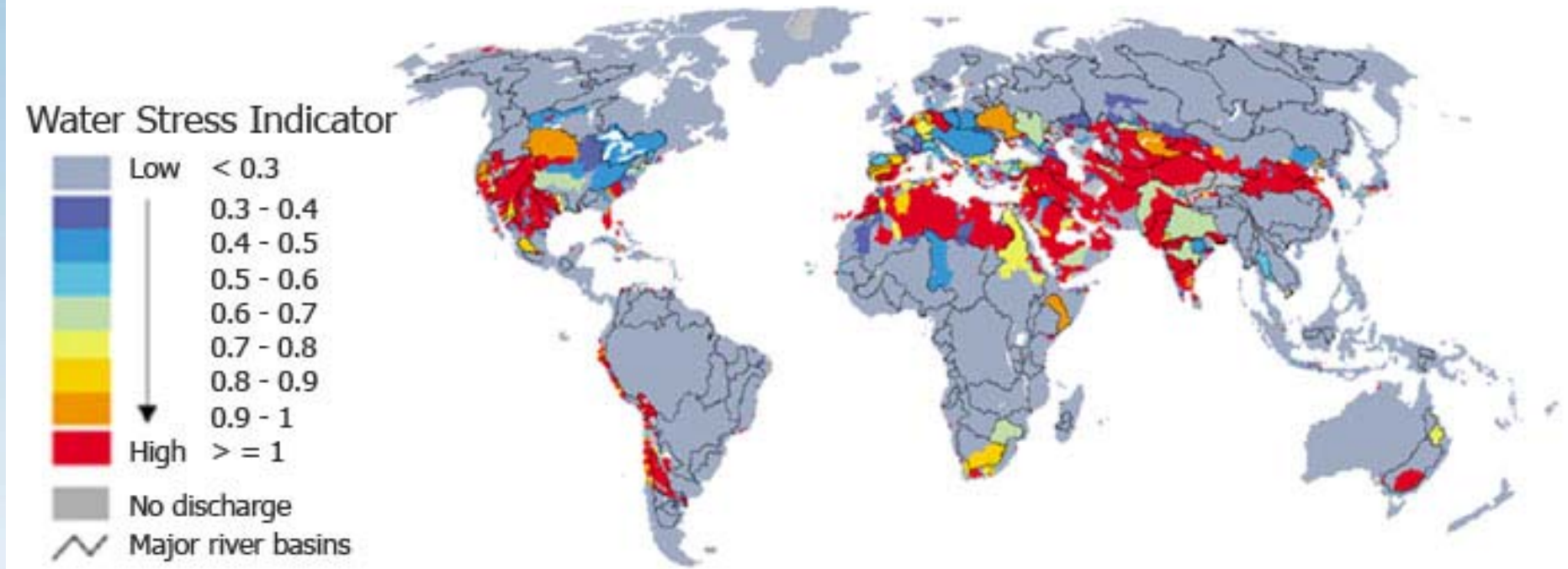
It's so dry, even March is fire season



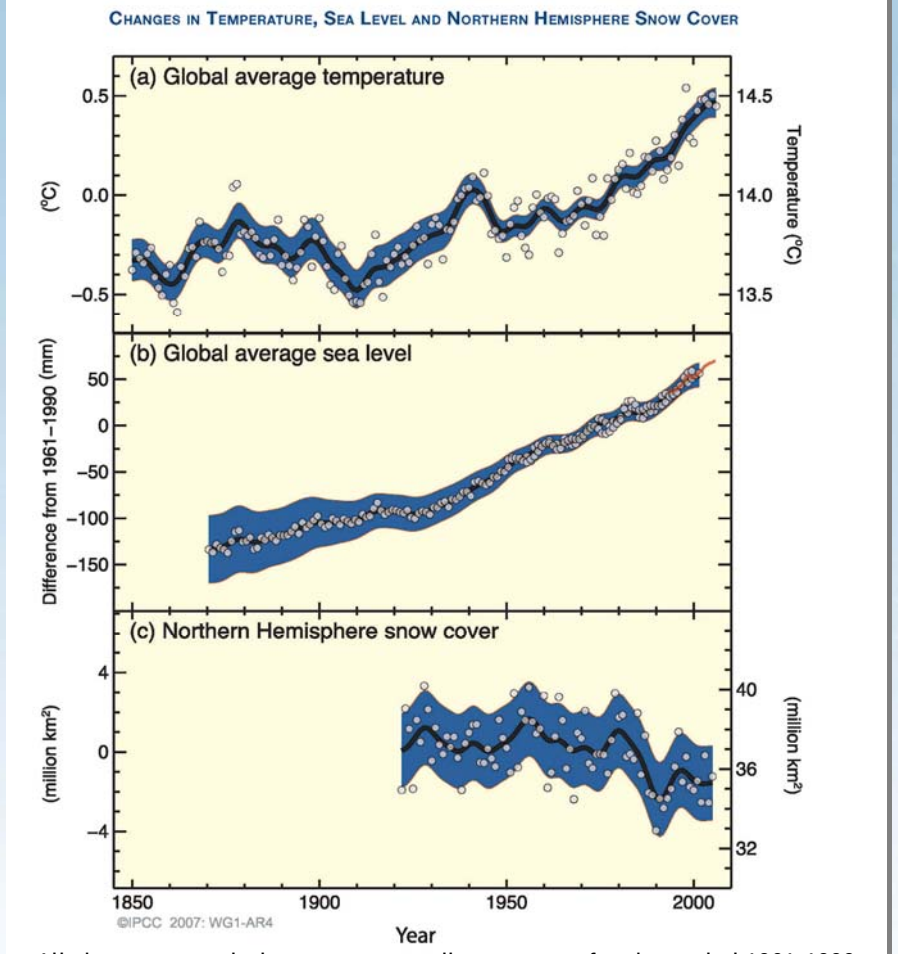
World Leaders Believe This Is Real!

- "Water scarcity may be the most under appreciated global environmental challenge of our time"—*World Watch Institute*
- "I have come to believe that water quality and quantity issues will pose the greatest environmental challenge of the 21st century"—*Governor Christine Todd Whitman, Former USEPA Administrator*
- "The wars of the 21st century. . ."

Water Is Most Scarce in Primary Areas of Global Population Growth and Industrial Development



Climate Change Is Dramatically Affecting Water Risk

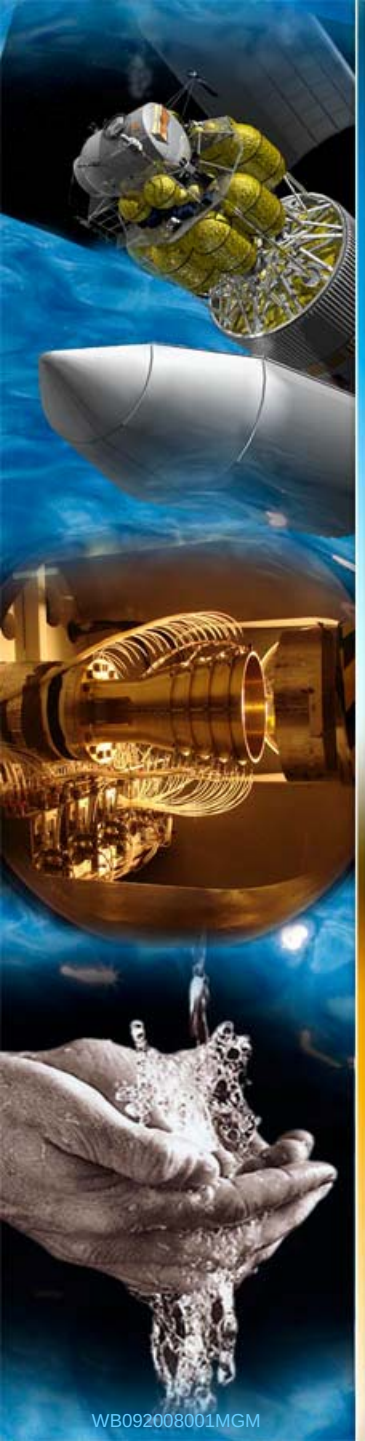


All changes are relative to corresponding averages for the period 1961–1990

- Shifting weather patterns are affecting precipitation and hydrologic patterns
  - Reduced surface water and higher salinity
  - Falling groundwater levels
- Climate change uncertainties lead to change in regulatory planning on water resources
  - Competition for water rights
  - Re-prioritizing hierarchy of water use

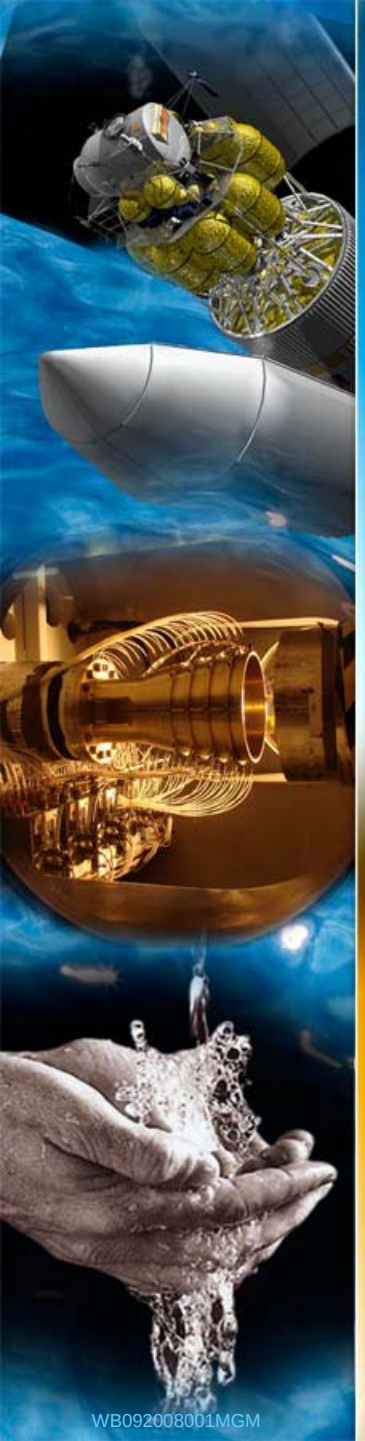
NASA and Its Contractors Have Many Critical Water Uses!

- Water supply for personnel
- Personnel and equipment cooling
- Boiler feedwater
- Deluge for engine firing



NASA and Its Contractors Have Many Critical Water Uses!

- SRB post-flight processing
- Process uses
  (i.e., cleaning/coatings, manufacturing)
- Disposal of wastewater:
  - Stormwater from facilities
  - Cooling tower and once-through cooling
  - Process water discharge
  - Treated sewage

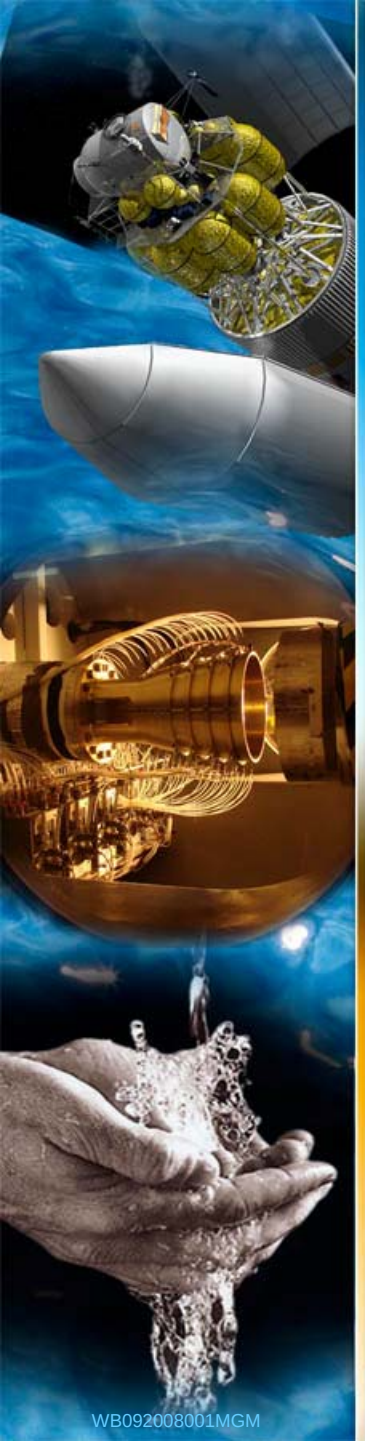


There Are Many Signals That "We're Not in Kansas Anymore" Regarding Water

- **Signal One:** Total water costs are increasing in unexpected ways
- **Signal Two:** Business disruption risks are growing
- **Signal Three:** Customer and stakeholder demands regarding water are growing

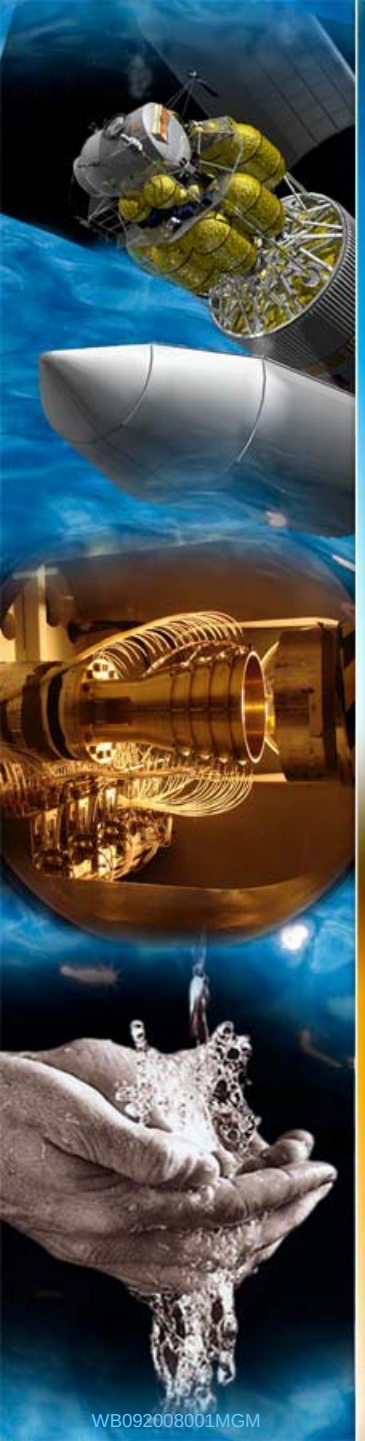
Conclusion:

An entity's "license to operate" and expand is increasingly tied to water-related issues.



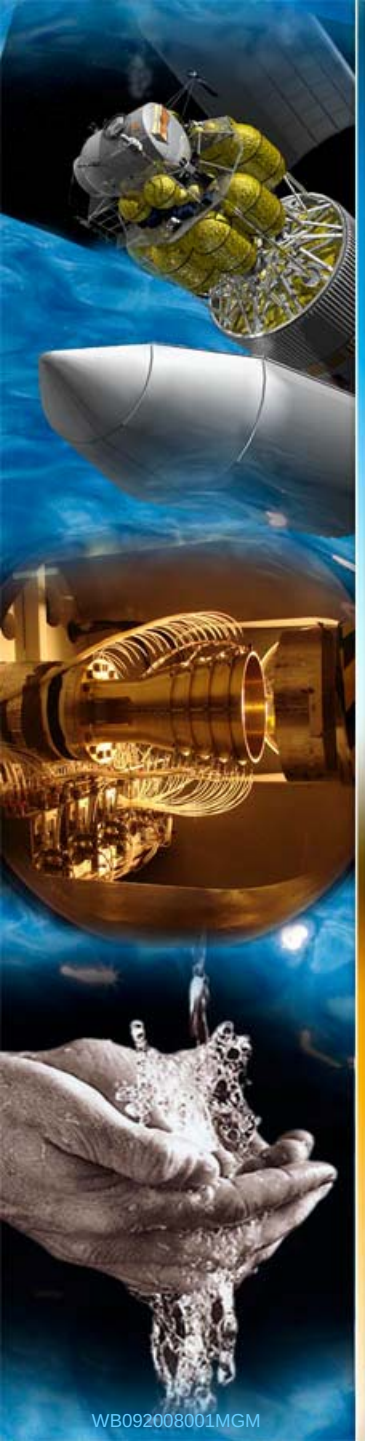
Signal One: Total Water Costs Are Increasing in Unexpected Ways

- Costs to treat wastewater
  - Chemicals
  - Energy
  - Disposal of residuals
- New supplies are expensive
  - Wells
  - Water utility impact fees for increased use
- Disposal costs/effluent quality targets
  - Many new regulatory requirements



Signal Two: Business Disruption Risks Are Growing

- Decreasing supply in critical areas
- Decreasing water allotments
- Future allocation changes?
  - Human uses
  - Ecological uses
  - Industrial uses



Signal Three: Customer and Stakeholder Demands Regarding Water Are Growing

- Stakeholders are demanding minimal to no impacts on water supplies and water bodies
- Pressure on the tradeoff between industrial and personal use
- Most regulatory programs have provisions for input from stakeholders
- Potential impacts on NASA's brand image?

Water Supply Drivers and Constraints

Increasing Need for Water

- Increasing population
- Increasing industrialization
- Mismanagement of resources
- Land degradation

Finite Water Resources

- Unreliable supplies
- Declining quality

Water Risks Threaten an Entity's License to Operate

14 | Friday • September 20, 2002 www.mid-day.com

Business

William Styron

A great book should leave you with many experiences, and slightly exhausted at the end. You live several lives while reading it.

Locals want MNCs to stop damaging environment

18 years after Bhopal gas tragedy, the world is reacting to corporate misuse

Robin Abreu
robin@mid-day.com

IN 1984, when thousands of people were killed in Bhopal due to release of lethal gas from the US-based pesticide company, Union Carbide, there was a furore throughout the world. The reason: innocent people died without a single warning as the gas spread through Bhopal.

Eighteen years later, multinational companies (MNCs) are still at it — constantly and thoughtlessly damaging the ecology of weaker, third-world nations. Thankfully, today, the locals as well as the governments world-over are reacting to this insensitive behaviour by MNCs and demanding them to stop the violation.

Recently the Supreme Court of India served notice to Coca Cola and Pepsi, charging them with violation of environmental laws — specifically, the Forest Conservation Act of India — for having caused damage to many 100-year-old eco-fragile rocks by painting advertisements on them.

AP

SAVING NATURE'S RESOURCES: *This Australian Marine Oil Spill Centre at Sydney harbour was established in 1991 as an initiative of the industry to maintain the integrity of marine environment*

As a response to the notice, Pepsi's official said the affected Manali-Rohtang region are franchisee-owned where the corporate office has little control and Coca-Cola said it is an extremely environment-conscious company, and what has happened seems to be a localised slip-up. Coca-Cola promised to ensure it wouldn't happen again.

Here's another instance of an MNC's greed destroying livelihood in a third-world nation: In Plachimada, Kerala, Coca-Cola Beverages Pvt Ltd is not only depleting the ground water resources (of about 15 million litres per day), but also polluting the resources of tribals, dalits and small farmers by regular release of chemicals and other effluents.

In the Yanacocha area of Peru, the US mining company Newmont has been mining for gold. Last year alone, Newmont mined over one-and-a-half times as much gold as Pizarro and the Spanish conquistadors took from the entire Incan empire!

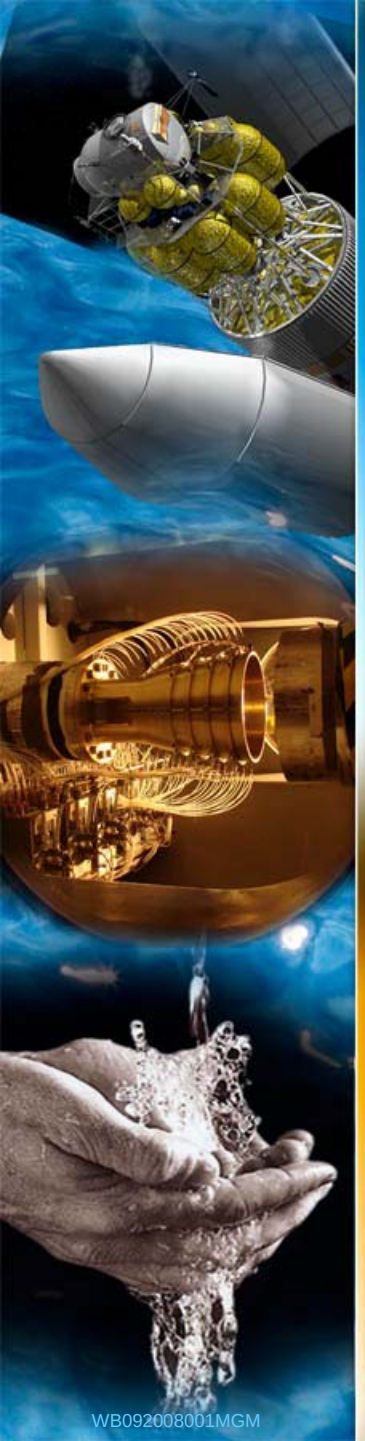
Sadly, while Newmont earned a profits of over $94 million in 1996, they only put $4 million back into the local Peruvian communities. The small local communities surrounding Yanacocha don't have running water, sewage lines, telephones or electricity. And Yanacocha's local rivers are already severely polluted by the toxic cyanide the company pours over the ore to extract gold.

One positive news is that the communities are now fighting back. In a setback for the MNCs, a US federal appeals panel this week ruled that companies hurting a third-world nation's economy in any way can be held liable in the US courts for human-rights violations.

The ruling accuses El Segundo, a division of US-based Unocal Corporation, of turning a blind eye to alleged human rights abuses, including murder and rape, against Burmese villagers who were forced by the Myanmar soldiers to work on Yadana Pipeline — the $1.2 billion natural-gas pipeline.

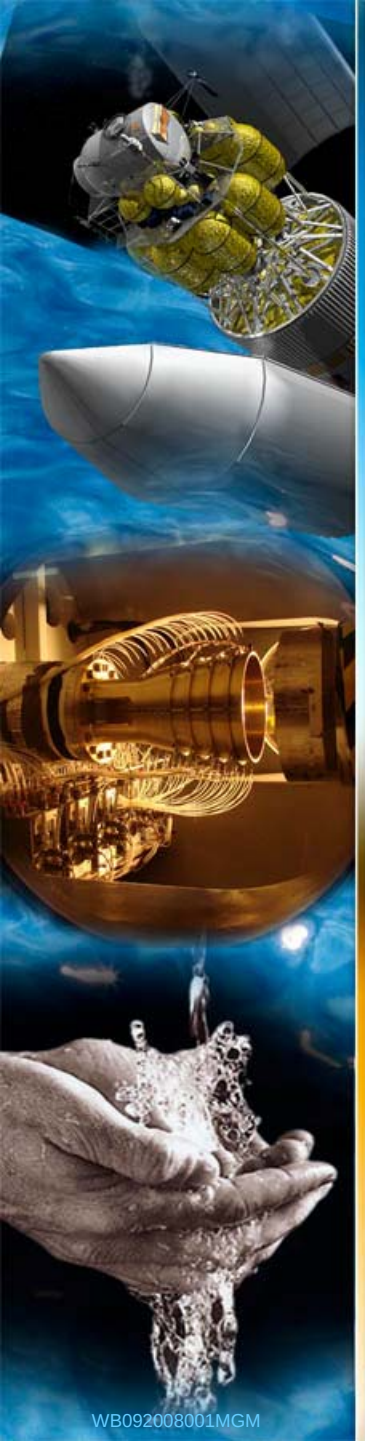
The decision by a panel of the ninth US Circuit Court of Appeals in Pasadena, California, was seen as a breakthrough for foreigners seeking to hold MNCs accountable for their alleged complicity with repressive foreign regimes in human rights abuses. At least 10 similar lawsuits are pending around the US against corporations, including Chevron Texaco and Coca-Cola, and human rights lawyers have several other cases waiting in the wings.

The legal battle began six years ago when Burmese villagers filed suit in a US federal court demanding that Unocal pay tens of millions of dollars in damages for the alleged abuses committed by soldiers along the Yadana Pipeline.



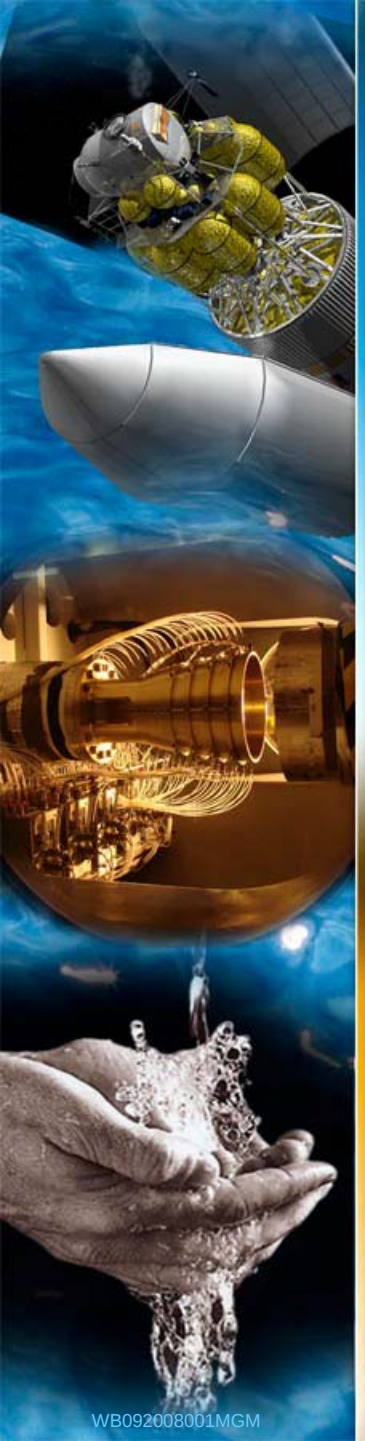
Water Disposal Presents Many Regulatory-Based Business Risks

- Clean Water Act
  - NPDES Effluent Guidelines
  - Water quality-based effluent limits
  - Total Maximum Daily Loads (TMDLs)-water basin specific pollutants (e.g. nutrients, mercury, toxic/carcinogenic substances).
- Endangered species
- Aesthetics
- The intersection of supply and disposal



Water Use Presents Regulatory-Based Business Risks

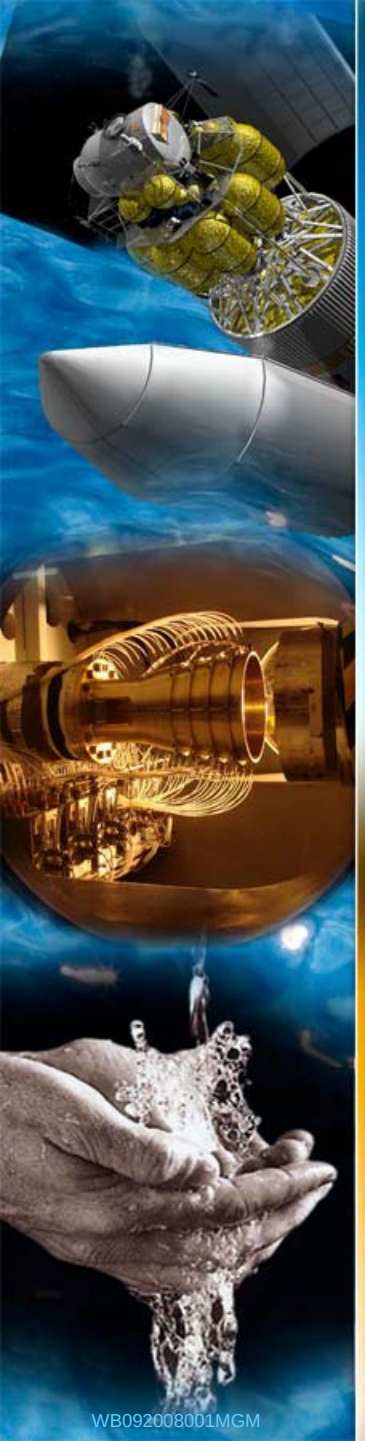
- New regulations regarding quality limit toxics (e.g., lead, solvents) and may limit available supplies
- Limits on new reservoir construction
  - Could you build a significant new reservoir?
  - Ecological impacts major concern
- Instream flow effects
  - Regulations on intake structures
  - Changes in downstream flow regime may limit ability to withdraw water



Water Disposal Presents Many Regulatory-Based Business Risks

NPDES Permitting Changes:

- Continued consideration of new effluent and treatment technology guidelines which may affect NASA
  - Continued push towards "NPDES"
- Tighter monitoring requirements
- Antidegradation regulations
  - Is your environmental impact worth your contributions?
- Aquatic toxicity considerations
  - Biomonitoring
  - Instream biological studies

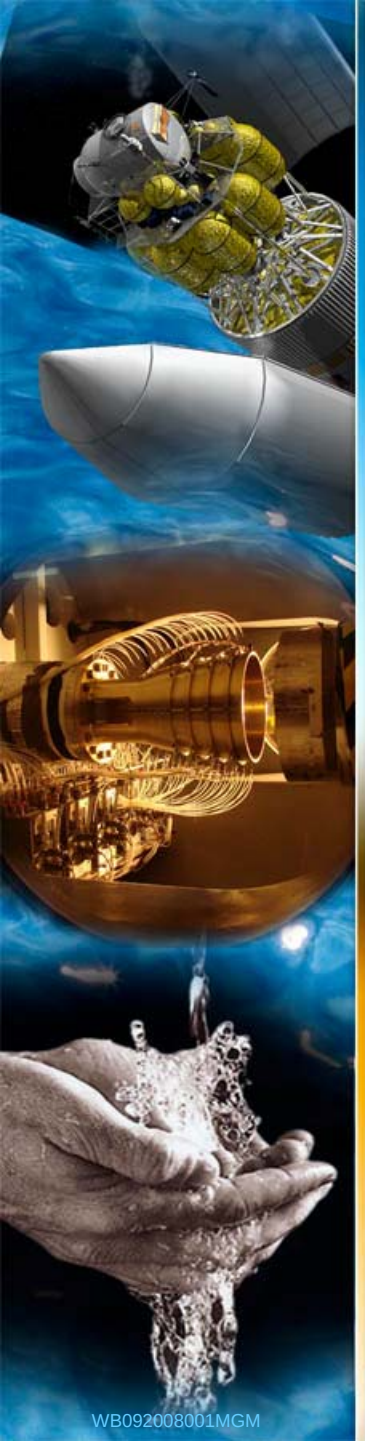


Water Disposal Presents Many Regulatory-Based Business Risks

Water Quality Standards Changes:

- Bioaccumulative and toxic compounds are a major focus
  - **Mercury***
  - **Ammonia***
  - **Lead***
  - **Silver***
  - **Selenium***
  - Pharmaceuticals

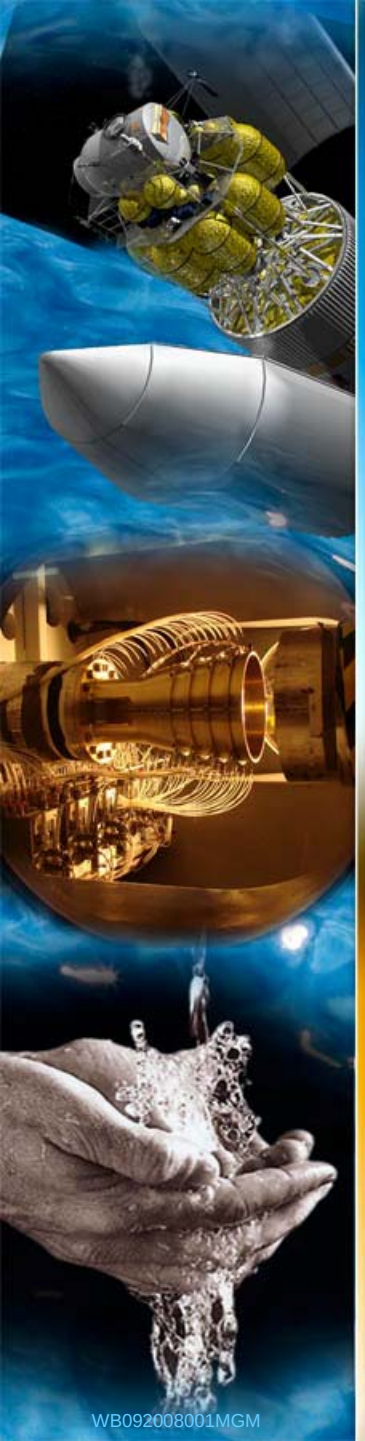
**NASA uses these substances in its value chain!*



Water Disposal Presents Many Regulatory-Based Business Risks

Water Quality Standards Changes:

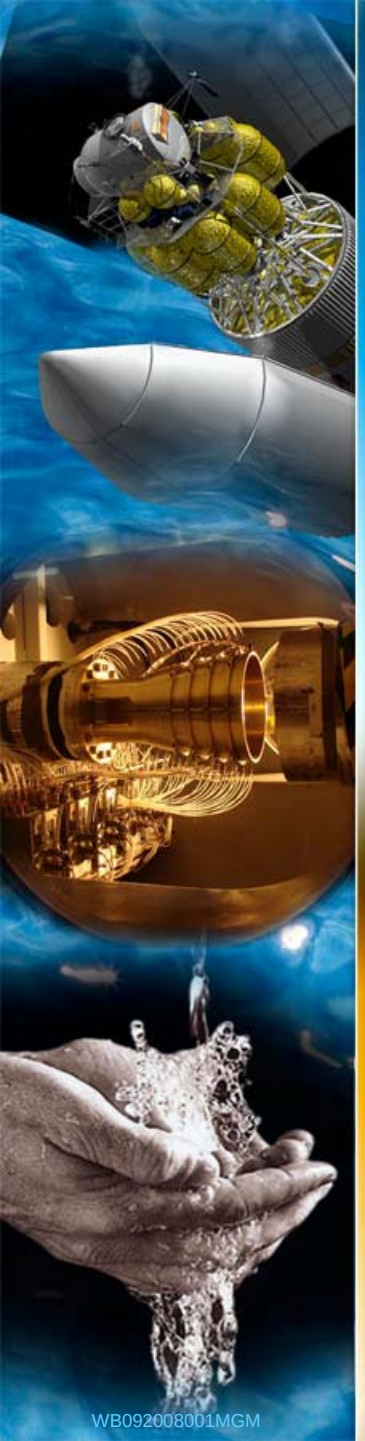
- Consideration of threatened and endangered species issues
- These can apply to *all* wastewaters
- There are possible changes in toxicology reviews which lead to regulation



Water Disposal Presents Many Regulatory-Based Business Risks

Total Maximum Daily Loads (TMDLs):

- Site-specific application of water quality standards for the receiving water body
- Go beyond technology based effluent limitations and consider the receiving stream water quality
- Typically focuses on nutrients, metals, aquatic toxicity, and toxic chemicals



Water Disposal Presents Many Regulatory-Based Business Risks

Total Maximum Daily Loads (TMDLs):

- Develops target for total mass input of target pollutants to the watershed to meet water quality criteria
- Will result in allocations for dischargers to a drainage basin for target pollutants
- Allocations affect all types of effluents
- Development can take years (decades?)

NASA and Suppliers: The Roles of Water and Associated Risks

Business Needs

Inside the Fenceline:
- Water for operations
- Ability to discharge

Beyond the Fenceline:
- Healthy communities and workforce
- Strong supply chains

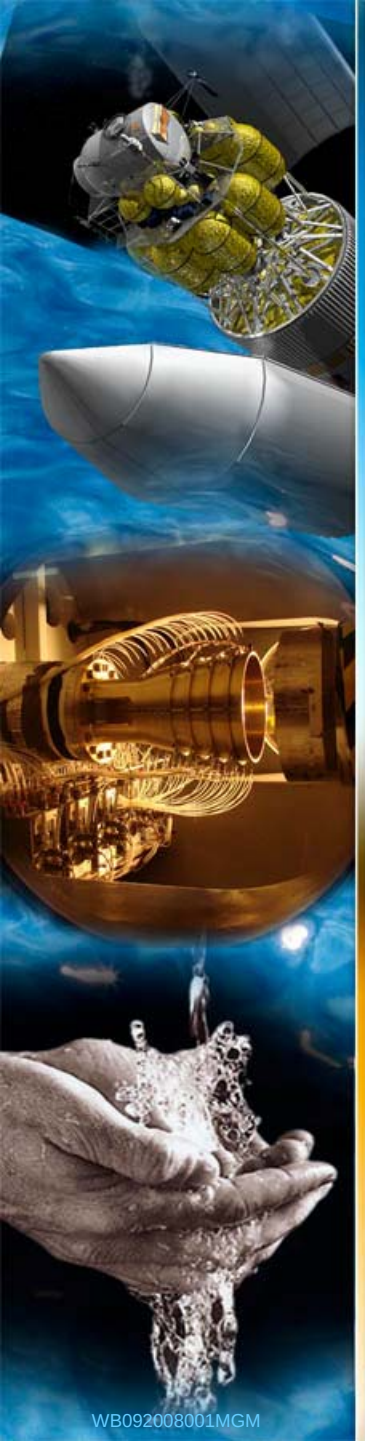
Beyond the Horizon:
- Access to clean water for product use

Areas of Risk

Inside the Fenceline:
- Stranded assets
- Rising costs

Beyond the Fenceline:
- License to operate
- Community & regulatory pressure
- Employee health
- Competing industries
- Supply chain interruptions

Beyond the Horizon:
- Brand image



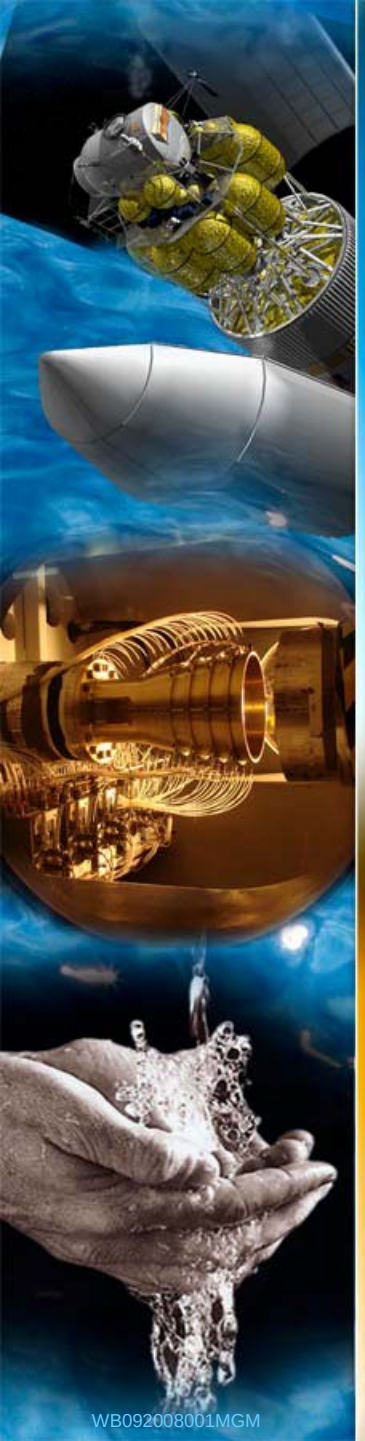
One Approach: Assess the Risk and Develop Mitigation Strategies

- **Step 1:**
  Water Use, Impact and Source Assessment
- **Step 2:**
  Water Use Risk Assessment
- **Step 3:**
  Develop Mitigation Strategies

VALUE → **Full Perspective on Water Risks, Opportunities and Costs of Change**

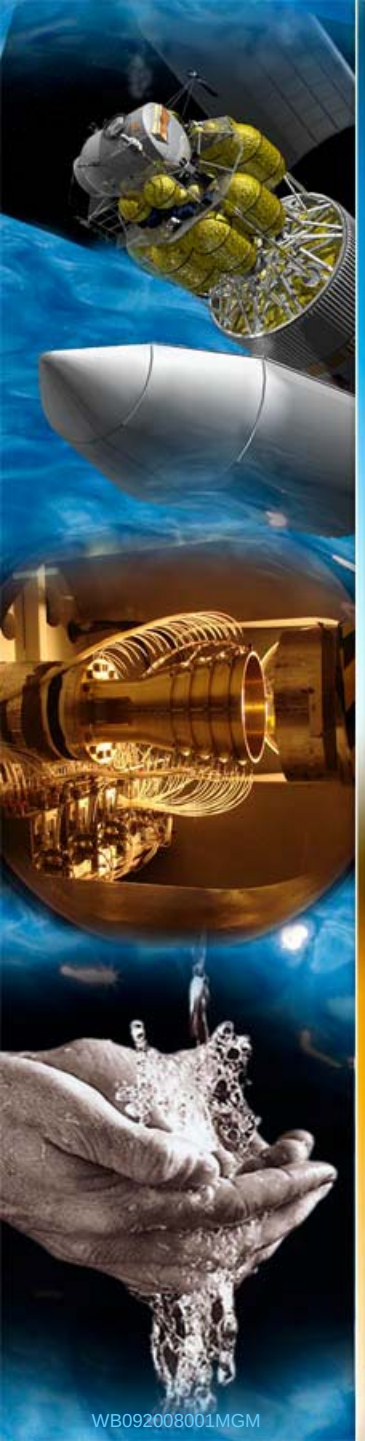
Step 1: Water Use, Impact and Source Assessment

- Identify and characterize water uses
- Identify and characterize water impacts from effluent disposal
- Identify and assess water sources
  - Water use sources
    (Permitted? What quantities over what duration?)
  - Water impact sources



Step 2: Water Impact Risk Assessment

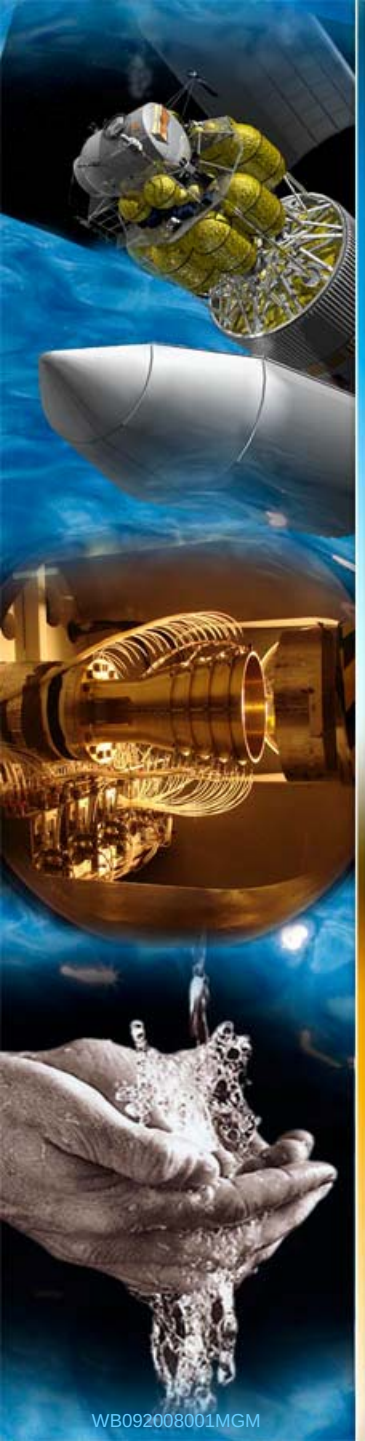
- Water use risk assessment
  - Significance of water use
  - Probability of change in water source
  - Impact reduction cost sensitivity
  - Source vulnerability
  - Water quality regs
- Water disposal impact risk assessment
  - Significance
  - Probability of changed requirements
- Prioritization of water-related risks



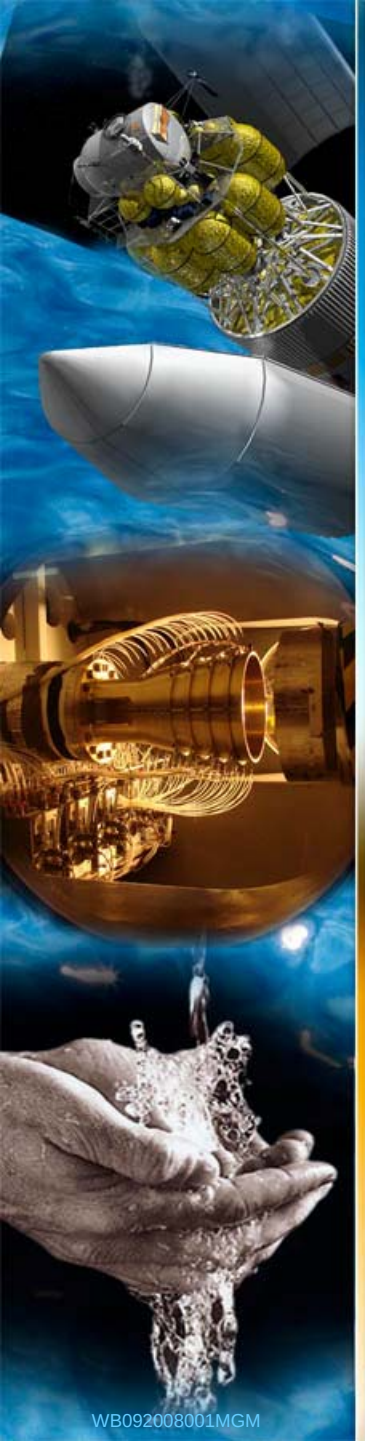
Step 3: Develop Mitigation Strategies

- Consider developing sustainable approaches
- Emphasize reuse and reduction alternatives
- Evaluate possible uses for effluents
- Associate strategies with cost reduction

Bottom line is to develop the optimum balance of cost and risk mitigation

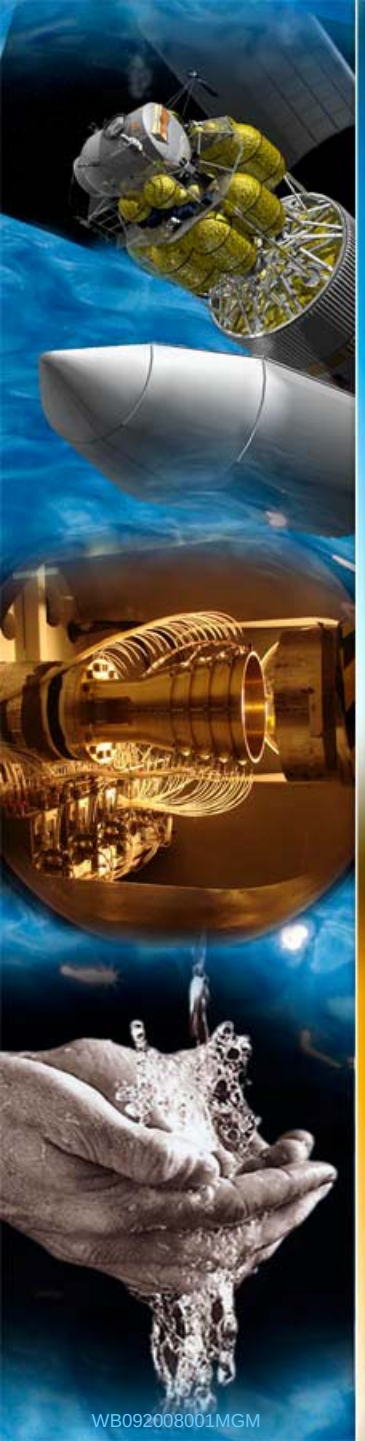


The GEMI Tool is a great example of a method to develop an integrated water strategy



Recommendations Regarding Water-Related Mission Risks

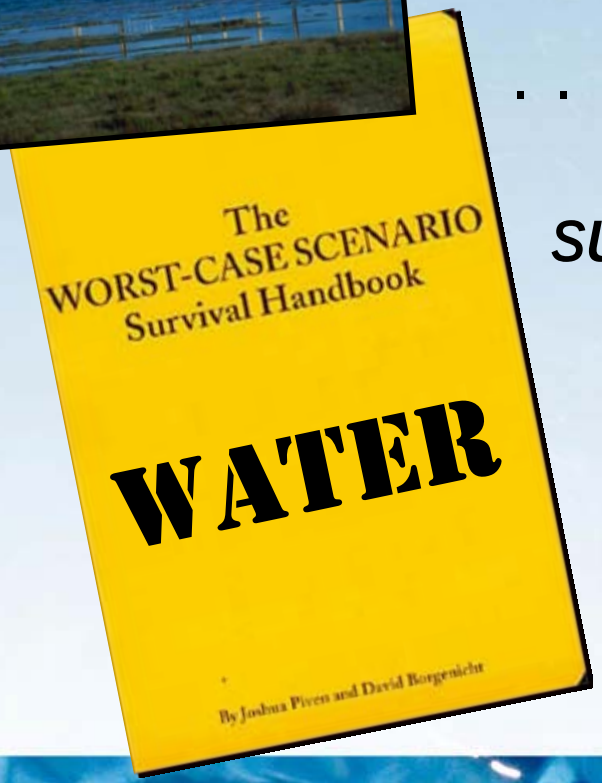
- Perform a water use study and develop options for reduction
  - Assess costs and payback (typically there are reasonable paybacks)
  - Whether or not an overall study is performed, this is the first step
- A holistic, systematic assessment approach to strategy development is needed
  - Consider supply and disposal sides of the equation
  - Link risk identification with mitigation measures
- Consider using a risk mitigation tool or framework to assess risks



Recommendations Regarding Water-Related Mission Risks

- Consider similar evaluation for key mission support contractors
  - Audit consideration?
- Use the NASA Principal Center for Regulatory Risk Analysis and Communication (RRAC PC) for tracking important regulations
  - Think long term . . . !
  - There may be “local” regulations that deserve in-depth evaluation

In Summary,



Realize that water impacts are beyond the fenceline . . .

. . . and plan for change to

sustain the mission.